5 Colby silt loam. Apparently the greatest injury caused by grinding for one hour is noted in the case of sandy soils.

When the soils were ground for 8 or 24 hours, there was an enormous decrease in the bacterial flora. This is readily noted from the figures of the last three soils given in Table I. After 24 hours of grinding the soil was rendered almost free of bacteria.

It is of interest in this connection to note the effect of long grinding on other soil organisms, *e. g.*, soil protozoa. Dilution counts on various culture solutions adapted to protozoa showed that the unground soils contained protozoa in dilutions greater than 1 to 10,000, while in many cases the ground soil failed to show any growth of protozoa. The garden soil, No. 12, contained protozoa in the first dilution, one gram in 10 c.c. of the medium. When ground for 24 hours this same soil did not show the presence of protozoa.

From the results, it seems fair to conclude that grinding soil in a ball mill injures the soil microorganisms. If this process is continued for several hours, the soil will be partially sterilized. Although no definite study has been made, it is most probable that the larger forms of plant life as fungi, yeasts and algæ suffer the same fate as the protozoa and bacteria.

E. B. FRED

UNIVERSITY OF WISCONSIN

AN ACOUSTIC DEMONSTRATION BEARING ON THE PULSE THEORY OF RADIATION

SOME years ago I made the acquaintance of the "pulse theory" of radiation. As I understood it then, the periodicity of any monochromatic light as observed by means of a spectral system was a function of the instrument of dispersion. If so, how various sources could give different spectra when their radiation was dispersed by the identical instrument was to me an unanswered question. It was unthinkable that there should not be some characteristic difference between the pulses, or their manner of succession, in the two cases.

The demonstration which I am about to describe developed as the result of a more recent informal discussion of the subject in this laboratory. It occurred to me that the acoustic analogy of such a theory should have as its consequence this fact: that an irregular series of impacts would cause wave disturbances in the air such that a resonator of any period, within certain limits, should respond.

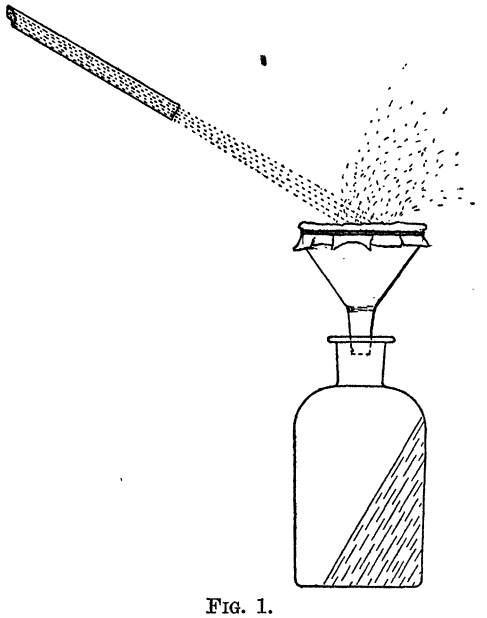

FIG. 1.

Such a series of impacts was furnished by a stream of sand-particles falling against an inclined paper surface, and the resonator was the classic glass bottle, which was made to respond to different periods by introducing different amounts of water.

Essentially the experimental set-up (which was about twenty minutes in construction) consists of a vertical glass tube of 7 mm. bore, constricted to about 4 mm. at a point near its top and some 42 cm. from its lower end; of a funnel, whose expanded end is covered with a rather loose diaphragm of thin tracing paper; and the resonator described. The sand was allowed to flow through the constriction in the tube, and the stream subsequent to this was kept from spreading too much by the portion of the tube below, falling freely a distance of 12 cm. from the lower extremity of the latter before striking the diaphragm (Fig. 1). The sand was what is known to the drug trade as

"fine silver sand," from which the smaller particles, to the extent of about one third of the mass, had been sifted out for another purpose. There is to my knowledge nothing critical about these specifications. They are simply the result of guess and circumstance, with the result about to be stated.

Several resonators were tried until one was found that worked properly in the position shown in the figure. Along with the general hiss and roar of the impact of the stream a faint, fluttering musical tone could then be distinctly heard when the ear was held close to the mouth of the bottle. By repeating the experiment with various amounts of water in the bottle tones of various pitches could be obtained, in every case sensibly identical with the tone obtained by blowing across the mouth of the bottle.

It would seem in advance that out of a helter-skelter series of impacts a group could be selected having, within certain limits, any given period with a sufficient degree of accuracy to set a resonator into action. Naturally such a state of things could not continue indefinitely. The individuals of the group could be expected to get out of step, stop the resonance by interference and set it going again in another phase. Hence the fluttering quality of the note, due apparently to the separate wave-trains so set up.

If the regular periodicity is a function of the analyzer, how may two pulse-series as supposed in the case of black-body radiation at two different temperatures give rise to characteristically different spectra? The answer to this question seems to me now quite natural. If we consider the effect, in this experiment, of varying the size of the constriction which limits the outflow of sand, it seems probable that increasing the outflow, by increasing the average number of impacts per unit time, would cause the resonator to give relatively greater response (as to amplitude or energy) at higher frequencies and *vice versa*. Another condition bearing on the "spectral distribution" of energy in this case would seem to be the relative numerousness of the different-sized particles composing the sand; other conditions being equal, the smaller ones presumably tending on the whole to give rise to high, the larger to low frequencies. This is merely speculation, as the careful experimentation necessary to show such changes has not been carried out.

The experiment as described here is scarcely demonstrable to more than one person at a time. It has certainly yielded large educational returns, to me personally at least, considering the insignificant outlay of time and material. I am especially interested in knowing whether it is essentially new or whether it has been proposed or used before.

P. W. Cobb

Nela Research Laboratory,
National Lamp Works of
General Electric Company,
Nela Park, Cleveland, Ohio

A PRIMARY CIRCUIT KEY FOR QUANTITATIVE INDUCTION WORK

Physiological investigation requiring either the calibration of an inductorium or the use of such calibrated inductorium necessitates a

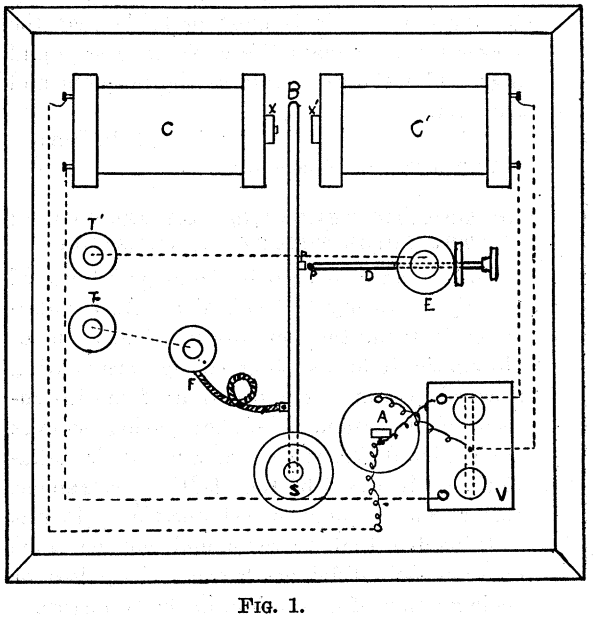

Fig. 1.

"make" and "break" key in the primary circuit which possesses certain qualities. Each